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27 March 1984

West Europe Report

SCIENCE AND TECHNOLOGY

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WEST EUROPE REPORT SCIENCE AND TECHNOLOGY

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WEST EUROPE REPORT
SCIENCE AND TECHNOLOGY

CONTENTS

SWEDEN INVENTS NEW CERAMIC FOR MORE DURABLE CUTTING TOOLS

Stockholm NY TEKNIK in Swedish 15 Dec 83 p 27

[Article by Lars Pekka]

[Text] A new "superceramic" is being developed at the Department of Materials and Machining Technology of the Technical University of Lulea.

The new ceramic could replace previous materials of machine steel for turning castings and other material that causes heavy wear on the tool.

The new material has proven to be highly resistant to wear and high temperatures, as well thermal shock.

The material is silicon nitride based and is produced by hot isostatic pressing (HIP:sintering under 2,000 atm of pressure at about 1,600 degrees). Such a press is now being installed at the Technical University of Lulea, after a total of 2.7 million kronor was donated by the Norrland Fund, the Kempe Fund, the Wallenberg Foundation, and IVF (Institute for Engineering Research).

Silicon nitride can be produced from quartz sand and nitrogen in the air, which means that the raw materials are unlimited.

Difficult To Sinter

The materials that are most comparable to the Lulea ceramic are hard metals (possibly coated), oxide ceramics, cubic boron nitride, and industrial diamonds.

Nitride ceramics differ from conventional ceramics in that the former are difficult to sinter. In order to facilitate formation of the required liquid phase, metal oxides are added to a silicon nitride powder.

The silicon nitride ceramic has an extremely low coefficient of heat expansion (does not change shape) which makes it insensitive to temperature changes, especially sudden large changes.

So far, however, the ceramic has proven to be relatively sensitive to blows.

In order to correct this shortcoming, basic studies of the ceramic's

grain-boundary phases are now being conducted at the Technical University under the leadership of Prof Kennet Eesterling.

So far, the sintering has been done at Asea's high-pressure laboratory in Robertsfors.

If the mechanical properties can be improved, the ceramic should be suitable from a technical standpoint for use in cutting tools. With support from STU (Swedish Board for Technical Development), Dr Harald Herbertsson and Prof Lars G. Akerberg are evaluating the technical and economic prospects of the ceramic material.

Much special equipment is required for the laboratory testing of high-performance ceramics. Extreme temperatures and extreme mechanical stresses are involved.

Practical Tests

"We must test the ceramic material just like tool steel in practical use," Harald Herbertsson said.

This has been done at Norrbit AB in Haparanda, where disc brakes are made from cast iron using oxide ceramic tools.

"So far the results have shown that our ceramic makes it possible to use considerably higher cutting speeds than with oxide ceramics. Our ceramic also has a longer lifetime," Herbertsson and Akerberg said.

Extensive research and development in the field of ceramics is underway in England, Japan, the United States, and West Germany.

There, however, low-pressure sintering is used. This does not guarantee a pore-free material as the HIP process does.

Thus, the Lulea ceramic is guaranteed to be solid and free of pores.

The new "superceramic" consists of variants of high-pressure sintered material in the Si_3N_4-SiO_2-Y_2O_3-Al_2O_3 system. It is produced as follows.

Quartz sand and air are treated chemically to form a powder with a grain size of 1/1000 mm with a Si_3N_4 base. This is treated with metal oxides. Then the material is cold-pressed into a solid, after which it is enclosed in glass under a vacuum.

The material then is placed in a hot isostatic press and is sintered at 1,600 degrees under a pressure of 200 MPa (2,000 atm).

9336
CSO: 3698/272

FRENCH CNES APPROVES FR 4 BILLION BUDGET FOR 1984

Duesseldorf VDI NACHRICHTEN in German 27 Jan 84 p 4

[Article by H. W. K.: "France's Astronautics--More Money for National Projects: 4 Billion Francs"]

[Text] Despite the tight general financial situation in France the French Ministry of Research and Industry has authorized for 1984 funds amounting to 3.6 billion French francs (about DM 1.18 billion) for the national astronautics agency CNES [National Space Studies Center]. In comparison with last year this means a gross budget increase of 35 percent which after deduction for an 8-percent inflation rate is still an increase by 27 percent. From the defense and post office ministries of France the CNES is receiving an additional amount of 474 million French francs (about DM 155 million) so that the total budget of the CNES for France's national astronautics project this year is about 4 billion French francs (about DM 1.3 billion). In contrast the FRG is investing about DM 421 million.

With the budget of 4 billion francs the aeronautics agency is in a position to finance the last development stage of some important satellites as well as being in a position to commence another, besides initiating preliminary studies and preliminary work for the future sector of transport rockets. In detail what is involved is the French terrestrial exploration satellite "Spot" which from its orbit will make black-and-white and multispectral pictures of the earth which will be commercially marketed by the newly set up "Spot"-picture organization. The satellite launching is planned for 1985.

The regional French direct television communications satellite TDF-1 is also to be launched in 1985. Its manufacturing status is at the present time 3 to 4 months in arrears of the projected plan; more significant, of course, is the recent decision of the French Government to review the need for this satellite project (see also VDI NACHRICHTEN, February 1984).

The new satellite project called "Athos" is a joint French-American enterprise for maritime surveillance and is intended to support the current national projects "Poseidon" (France) and "Topex" (United States).

In addition, financial support will be forthcoming for the planned microwave earth exploration satellite ERS-1 of the European Space Agency (ESA) as well

as for the commencement of the development of a high-thrust high-energy rocket engine (type HM-60) for a version of the "Ariane-5." This new engine in the 1-MN thrust class for which the preliminary development costs are estimated to be about DM 500 million would (in the years after 1995/96) give a future "Ariane-5" a useful load capacity of about 15 metric tons for the low earth orbit and about 8 metric tons for the geostationary transfer orbit. This transfer orbit runs between 200 km and 36,000 km altitude above the surface of the earth and it will be from this provisional sharply elliptic orbit that geostationary satellites will be fired into their final 24-hour circular orbit at an altitude of 36,000 km. With this may be compared the corresponding useful load values of the present "Ariane-1" version: 4.85 tons in the low earth orbit and 1.75 tons in the geostationary transfer orbit ("Ariane-2" produces about 18 percent more).

With this development France would be in a position to launch manned space flights with the proposed French minishuttle "Hermes." This is a possibility and an opportunity which according to CNES president Hubert Curien is receiving within his organization more and more approval and recognition of its importance.

In contrast, the outlays for national astronautics in the FRG seem rather modest. In the 1984 finance plan of the German Federal Ministry for Research and Technology (BMFT) DM 704 million are provided--including, of course, the German contribution of about DM 403 million for the European Space Agency which must be deducted in any comparison of expenditures for national astronautics. To this must be added about DM 80 million for general astronautic engineering research within the DFVLR [German Research and Testing Institute for Aeronautics and Astronautics] as well as about DM 40 million for the German direct satellite TV-Sat (taken from the special funding by the German Federal Post Office). Thus in 1984 the FRG is expending for its own and for bilateral projects about DM 421 million. In comparison with 1983 this represents a budget tightening. By way of comparison the FRG budget is one-third of the CNES budget. This implies a substantial renunciation of spectacular large-scale domestic projects: the exceptions are the German infrared telescope "Girl" to be integrated as of 1986 into the space shuttle, the TV-Sat satellite and the high-altitude rocket research program. In-house developments by German firms such as the German reusable shuttle satellite SPAS-01 of MBB are only being partially subsidized.

8008
CSO: 3698/290

HEAD OF ESA ADVOCATES PARTICIPATION IN U.S.SPACE STATION

Paris AFP SCIENCES in French 2 Feb 84 p 16

/Text/ Erik Quistgaard, director general of ESA, on 31 January expressed his hope to see Europe participate significantly in the construction of the future U.S.space station. It would be, according to him, a way to demonstrate that "the western world can agree on a long-term program in the space and peaceful technologies fields."

Mr Quistgaard answered along these lines questions asked during a press conference held at ESA headquarters by members of the shuttle crew at the time of the recent Columbia-Spacelab flight on U.S.-European collaboration in the U.S. space station project.

"I am sure that we shall achieve close collaboration because...in Europe there is great interest in this proejct," he stressed. But Europeans must be aware of what participation in construction of such a station implies at all levels (financial, technological, etc.) We have had good contacts with NASA on this matter. They must be followed up."

U.S.-European collaboration on Spacelab in the past has been good and the terms of the agreement respected by both sides. "But we Europeans have learned many things present and future regarding the station; "everything must be negotiable," added Mr Quistgaard.

Mr Ulf Merbold, first ESA astronaut, then stated that in his own opinion the space station of the 1990's "should be used only for peaceful purposes."

European participation in this vast project will be examined three times by the ESA council during the year, including among other things follow-up on the Ariane missile development program and the European mini space shuttle Hermes: on 23 and 24 February, in May or June and in the fall, so stated Mr Michel Bignier, ESA director of transports. The Agency might then make its feelings known at about the time when NASA may have a clearer outlook on its station project. ESA has furthermore recently become aware of a German-Italian project based on the Spacelab concept.

According to Mr Bignier, the next 6 or 8 months will allow the opposing concepts to be brought into line. West Germany, Italy, France and Great Britain are, of the 11 ESA members, those most interested in participation by Europe in the U.S. project.

9436
CSO: 3698/279

AEROSPACE

ARIANE WILL WAIT ONLY UNTIL 15 MARCH FOR DELAYED INTELSAT

Paris AFP SCIENCES in French 2 Feb 84 p 21

/Text/ The eighth European Ariane rocket will be made available to intelsat until 15 March but no later. So stated Mr Michel Bignier, ESA director of space transport, on 31 January. In fact, this rocket has been waiting since mid-January so that the eighth Intelsat V F-8 satellite might be launched.

The international organization has been delaying its launching since that date because Ford Aerospace company experts have still not succeeded in finding a technical solution for the malfunctions in the repeater designed for maritime communications of the Inmarsat organization, malfunctions observed since the geostationary orbiting of the fith and sixth models of this satellite.

ESA and the National Center for Space Studies (CNES) in fact want to have the Kourou firing range available to ensure the orbiting in early April of the first real commercial satellite ever launched by European rocket, the Spacenet-1 satellite belonging to an American company. For weeks a whole series of dates for the launching of Intelsat V-F-8 have been announced: the 22nd, the 25th and then the 28th of February.

On 31 January it was rumored that it might even be postponed until 3 March, but ESA and CNES both refused to confirm any of these dates without receiving a request from the international organization for a launching on a date specified by it.

At Kourou space center crews are proceeding with preparations of the launch vehicle on a very flexible firing schedule while Intelsat and Ford Aerospace experts continue working on the satellite.

9436
CSO: 3698/279

AUTOMOBILE INDUSTRY

RENAULT, PEUGEOT WORK ON FUTURE MODELS IN SECRET

Paris AFP AUTO in French 30 Jan 84 AFP 271855, 271900 Jan 84

/Text/ Paris--Everything must remain secret, claim manufacturers, because of competition, but also because of the many unavoidable fumbles in the research and development of a prototype, exploring many solutions before arriving at the "real" car.

These are the reasons which make the search for information about prototypes, often taking on the characteristics of a "photo safari," a major portion in the activities of the specialized press. PARIS-MATCH has just created a shock by publishing a photo of a moving car purported to be the "C-28" prototype. AUTOMOBILE-MAGAZINE published, on its front cover, a photo of the prototype which could become the "405."

The Peugeot company, which has still not disclosed either the date (end of 1985 according to some sources) of the first customer shipment of the C-28 or its make (Talbot or Peugeot), is offering no comments, thus leaving room for the most complete uncertainty.

It should be remembered that the first studies for the 205 date back to 1977, and that the final model was selected at the end of 1979. It should also be emphasized that preliminary studies, and computer-aided design carried out at the group level, generally take two and a half years before leading to the first operating prototype (designated 01) whose development and manufacturing will then become the responsibility of the group's automobile company concerned (Peugeot, Talbot, or Citroen), whose styling department may still make changes in the exterior and interior aspect.

As far as the C-28 is concerned, there could very well be several prototypes already operating, several types, of which only one will survive, indicate people at Peugeot. As far as the future Peugeot is concerned, it can be observed that it has not been photographed in motion. It could therefore only represent one of the even more numerous models that the styling department at Peugeot produces within the scope of a given project.

The C-28 project therefore seems more advanced than that of a Peugeot sedan that everyone refuses to call a "405" and which could have its place between the 305, first marketed in 1977, and the 505 which dates from 1979.

6445
CSO: 3698/276

BRIEFS

ELECTRONIC LPG INJECTION SYSTEM--PARIS--SOLEX UK has developed an LPG (Liquefied Petroleum Gas) injection system implementing electronic control of the air/gas mixture richness resulting in a 5 to 10 percent fuel saving as compared to existing systems. This LPG injection system will be marketed primarily in the Netherlands, England, and Germany through the LANDI-HARTOG affiliates that SOLEX is currently acquiring. France will also be an important market if the current prohibition to enable cars to operate alternatively on natural gas and gasoline is lifted, as it is being proposed. The mechanical parts will be manufactured in England and the control electronics will be manufactured by SOLEX-France. It will use an INTEL 8031 microprocessor. /Text/ /Paris AFP SCIENCE in French 2 Feb 84 p 53/ 6445

CSO: 3698/276

BIOENERGY, SOLAR BIOTECH RESEARCH IN FRANCE, EUROPE

Paris BIOFUTUR in French Nov 83 pp 27-36

[Article by M. F. Chevallier and R. Nussbaum: "Towards a Solar Bio-Industry"]

[Excerpts] [Boxed insert from p 31]:

The ARBS [Association for Solar Bioenergy Research] and the LBS [Solar Bioenergy Laboratory]

The ARBS was founded in April 1982 by the AFME [French Agency for the Harnessing of Energy] (formerly the COMES [Solar Energy Commission]) and the AEC [Atomic Energy Commission]. Its founder and first head was Mr Guerin de Montgareuil (Department of Biology, AEC). Its present head is Mr R. Villet.

The ARBS includes industrial partners, called "institutional members": Rhone-Poulenc, CFP [expansion unknown] and SNEA [National Elf-Aquitaine Company]. These institutional members will benefit from preferential provisions for the applicative development of acquired know-how. The CNRS [National Center for Scientific Research] is closely associated with the ARBS through a special agreement. The AFME and the AEC finance 80 percent of the budget; the remaining 20 percent is furnished by the CNRS and the institutional members. A third type of participation is provided for, namely, associate membership, which will involve access to general information on the progress of programs, at a fixed annual subscription fee. The first associate members are Carboxyque Francaise and Lyonnaise des Eaux.

At the Cadarache CEN [Nuclear Studies Center], the ARBS has a group of laboratories specializing in basic research, transfer research, and engineering studies: Photosynthesis laboratories, enzymology laboratories, solar biotechnology laboratories, and engineering group laboratories. Other units will be created, so that, between now and 1985, the ARBS will have some 70 persons in Cadarache.

The ARBS is developing at the LBS, headed by Mr C. Gudin, two biotechnological processes: Continuous culture and cell-immobilization culture.

[End of insert; excerpts from body of article follow]:

Research on the mechanisms of photosynthesis, using the first bio-industrial microalgal cultures... This article discusses these biotechnologies that make use of photosynthetic micro-organisms rather than fermentative ones, with the object of building a solar bio-industry to produce substances of industrial, nutritional and energetic interest. A subsequent article will discuss current basic research that could lead to the production of hydrogen by means of photosynthetic organisms. A third industrial revolution...

Solar biotechnology can be defined as a "conventional" biotechnology that makes use of solar radiation and unicellular photosynthetic systems.

Efficiency of Photosynthetic Conversion

The solar energy available per unit terrestrial surface is expressed in terms of energy flux:

--Of the 10,000 W/m^2 [watts per square meter] emitted by the Sun, 1,400 W/m^2 reach the upper limit of the atmosphere, and 1,000 W/m^2 reach the surface of the Earth in clear weather at the zenith (that is, noon at the equator).

--This figure becomes 580 W/m^2 if we allow for clouds and their mean coefficient of reflection (or albedo) of 0.42, and 145 W/m^2 if we allow for the fact that it is not always noon and that everyone does not live in the tropics.

It so happens that 145 W/m^2, the mean value for the Earth as a whole, is also the mean value of solar flux that falls on France (125 at Dunkirk, 130 at Paris and Nancy, 145 at Limoges and Macon, 180 at Carpentras, a little less at Nice, possibly a bit more at Cadarache).

This solar flux of 145 W/m^2 amounts to 1,100 tep [tons of oil equivalent] per hectare per year. This is a considerable amount of energy when it is recalled that in France the population density is one inhabitant per hectare, and that total energy consumption averages 4 tep per inhabitant per year.

Advantages of Unicellular Photosynthetic Systems

Solar bio-industries, which are based on simple photosynthetic systems, will have in common with agriculture, horticulture and silviculture the fact of all being solar-capture technologies. But unicellular photosynthetic systems, besides having certain constraints in common with their multicellular counterparts, have a number of advantages over them:

--An advantage of diversity in the degrees of evolution and adaptation to the ecological niches of the biosphere;

--An advantage as to the variety of accessible products at the different outputs of the metabolic cycle with diversified growing conditions (see diagram [not reproduced herein]). This advantage over fermentative micro-organisms is all the more substantial in that the substrata are simple, as has been pointed out;

--An advantage as regards speed in the growing phase (the biomass doubling time for unicellular algae is from 5 to 48 hours--with a mean time of 12 hours--versus from 1 to several weeks for plants);

--Hence, a productivity advantage (with large seasonal variations, of course): 70 to 100 tons of dry matter per hectare per year for unicellular algae, versus an average of 2 tons for the forest, 5 tons for wheat, and 10 for corn;

--An essential advantage in terms of flexibility, that is, the possibilities they offer for transforming photosynthetic micro-organisms, by using either genetic methods (selection, mutagenesis, recombination, fusion in the case of protoplasts), or by simply operating on environmental factors. An example with respect to this point is the algae of the genus Scenedesmus acutus. In a medium devoid of copper ions, the plastocyanine in its electron transfer chain is efficiently replaced by cytochrome C_{553}.

These advantages serve to bring out all the biotechnical potentialities of these adaptable, indeed transformable, unicellular photosynthetic systems.

The Problems

Their most manifest disadvantage at the present stage of the technology appears to be their very low energy-gain.

Every advance being made with respect to efficiency of conversion appears to be achieved at the expense of the gain, the extreme situations being represented on the one hand by forests and on the other by micro-algae.

Technological Sophistication and Reasons for Hope

Algal culture is not in itself a new thing. Brown and red macro-algae are being cultivated for their polysacharides (carrageenins and alginates, in regard to the production of which France, through the CECA [expansion unknown], ranks second and fifth worldwide) by means of "spirulines," cyanobacteria cultivated and eaten traditionally for their protein content by certain ethnic groups in Chad, Kenya and Ethiopia. Algal culture embraces large numbers of species and of artisanal and industrial processes. Major American, British and Italian projects have as their objective the applicative development of such technologies on a large scale in the form of what they call "marine farms."

Primitive technologies already make use of microalgae obtained from hydrobiology laboratories in open basins:

--For the biological purification of water: In this case, it is a microflora and a microfauna of widely diversified types that develop heterotrophically by way of the organic pollutants contained in waste water;

--For the production of proteins for alimentary and dietetic uses: The subject was discussed in the POU [expansion unknown] article in BIOFUTUR No. 9, January 1983, particularly as regards the culture of spiruline algae under the semi-natural conditions of Lake Texcoco;

--For the production of glycerol and pigments: This avenue has not really reached the industrial stage, but it appears to be a good candidate for biotechnological optimizations, since the products obtained have a substantial added value.

The Dunaliella Alga and Glycerol

The green photoautotrophic alga of the genus Dunaliella is commonly found in waters having a high salts content (it is found in the Dead Sea). Through a defense mechanism against high external osmotic pressure, it synthesizes and accumulates large quantities of intracellular glycerol: Up to 50 percent of its dry weight.

Optimal temperature and salinity conditions for cellular growth, on the one hand, and for the biosynthesis of glycerol, on the other hand, have been determined in the laboratory.

A clone of the genus D. bardawil was chosen for the red coloration it imparts to the medium: In addition to glycerol, it accumulates up to 8 percent of beta carotene, a high value-added pigment, precursor of Vitamin A.

World production of glycerol is estimated at between 450,000 and 600,000 tons annually, at a market price of 15 francs/kg in 1983. The by-products are various: Glycerophthalic paints and resins, explosives, quinoline compounds, substances used in pharmaceuticals, cosmetics and as foodstuff additives.

Initially a by-product of the soap industry, obtained by anaerobic fermentation in molasses, glycerol has gradually come to be supplied by petrochemistry from propylene. It is against this petrochemical process that the process of extracting glycerol from Dunaliella must be evaluated: The production cost for the Israeli process is 5.2 francs/kg versus 6.2 francs /kg for the petrochemical one, thanks to a budget item "energy and raw materials" divided by 4 and an "energy gain" of 1.9 versus 0.3 with propylene! On the other hand, the fixed costs, corresponding to investment and labor, are multiplied by 4 with algae, rendering them far less attractive! For the time being...

Two teams have worked on this technology: Messrs B. L. Chen and C. H. Chi of the Chemical Engineering Department, Monsanto Chemical Intermediates, and Messrs M. Avron and Ben Amotz of the Department of Biochemistry, Weizmann Institute. The latter work with Koor Foods Ltd of Israel. According to Mr Avron, the Koor process produces, in a 2-km^2 basin, 10,000 tons of glycerol a year, 500 tons of beta carotene a year, and 18,000 tons of proteins a year.

The process proposed by Chen and Chi differs from the Koor process as to methods of recovery and lysis of the cells and as to methods of separation of the biotic and abiotic phases.

The general siting requirements are quite "selective":

--Availability of sea water and salts (NaCl, nitrates, phosphates);

--Large drainable area of flat terrain for the open basins;

--Hot semi-arid climate;

--"Industrial" source of carbonic gas (for example, gas with a 7- to 15-percent content of CO_2, discharged by a thermal electric power plant, and after purification);

--Low labor cost.

Once these conditions have been met, the "massive and extensive" production of glycerol would involve the following stages:

--Culture in two batched stages: From a first basin in which the NaCl concentration is 1.5 M to promote rapid cellular growth, the biomass is poured into the glycerol production basin, where the salt concentration is raised to 4 M;

--Harvesting of the cellular biomass by various methods of decantation, filtration, solar drying in beds, centrifuging (by the Koor process), extraction using ethanol or by osmotic shock, pressing of the biomass (protein-enriched food);

--Recovery of the glycerol by evaporation and distillation.

Another industrial project is being developed in Australia in a unit that produces 300 tons a year of beta carotene (the investment was 5.4 million Australian dollars).

Possibilities also exist for producing glycerol on a commercial scale by biotechnological methods:

--Either by fermentation in n-butanol, 1,3 propanediol by Clostridium pasteurianum; Syracuse University, United States,

--Or by fermentation in beta-hydroxyl-propionaldehyde by Aerobacter aerogenes, followed by dehydration and oxidation in acrolein (acrylic acid aldehyde); U.S. Department of Agriculture, Northern Regional Research Laboratories.

In addition, the Microbiological Engineering Laboratory of the University of Montpellier (Professor Navarro) is working to define a method of immobilizing the Dunaliella alga. Several gels have been tried: Problems of resistance to

polymerization and of stability remain to be resolved. Operating on culture conditions, for example with cascaded reactors, it would be possible to render the cells permeable and to excrete the intracellular glycerol on a semi-continuous basis.

Algal culture becomes "solar biotechnology" from the moment the highest possible ratio of "desired product to indistinct biomass" (something like the "signal-to-noise ratio" in electronics engineering) is sought through improved control of production factors. In France, research in this domain is being conducted especially by the ARBS (see chart).

Although genetic techniques for broadening the light absorption spectrum or "creating outputs" in metabolic cycles are still in their infancy (at the stage of basic research on cyanobacteria), continuous-culture techniques have advanced very rapidly.

Continuous culture in closed tubular systems enables:

--Monoculture of a perfectly isolated species, or even the "superposition" of algae and photosynthetic bacteria for more complete utilization of the spectrum;

--Monitoring and automatic regulation (in sum, full and specific bioengineering) of the fluctions in inputs (luminous flux, thermal, gaseous...) and of the cultural and production parameters;

--A high cellular concentration (1 to 5 grams/liter of dry matter) as compared with open basins, yielding a more economical harvest.

Botryococcus Braunii and Hydrocarbons

On a geological time scale, accumulations of Botryococcus fossils have formed algal coals and bituminous schists and have been at the origin of certain oil deposits. The present pyriform-celled, colonial, ubiquitous alga grows just as well in fresh as in brackish waters, with extremely abundant proliferations (blooms) and hydrocarbon contents reaching as high as 75 percent of the dry weight of biomass.

Each cell is surrounded by several successive walls, comprising globular formations that collect 95 percent of the hydrocarbons produced by the algae. These extracellular hydrocarbons are not the result of an excretion process. Their synthesis takes place in the external wall, in the same zone where they are stored, starting from the oleic acid formed de novo in the chloroplast. The cells can also be separated mechanically from the external walls containing the hydrocarbons, and their recovery is thus facilitated. Two types of hydrocarbons have been characterized in Botryococcus:

--Normal linear hydrocarbons (^{25}C, ^{27}C, ^{29}C and ^{31}C of the alkadiene series);

--Branched and unsaturated hydrocarbons (polymethylene triterpenes or "Botryococcenes" of the generic formula $C_nH_{2n} - 10$).

The study carried out by the Bioorganic and Physicoorganic Chemistry Laboratory of the National Higher Institute of Chemistry in Paris (Prof. E. Casadevall, Dr C. Largeau, Dr P. Metzger) has enabled the attainment of biomass doubling times of 2 days (versus 8 days mentioned in the literature) during the period of exponential growth, which corresponds to a maximum hydrocarbons productivity of 80 to 250 mg per gram of of biomass per day. This shows that the high production of hydrocarbons results from the normal metabolism of the alga.

Possible Applications for the Hydrocarbons and Future Avenues of Research

Although the commercialization of Botryococcus hydrocarbons as sources of energy--hence, their large-scale production--has not taken a definite direction as yet, their applicative potential in fine chemistry--involving commercialization on a medium-scale--could become attractive over the very short term.

Once they have been transformed by chemical or microbiological methods, the Botryococcus braunii C25 through C31 alkadienes could be excellent substitutes for the natural waxes, particularly spermaceti wax. Through simple catalytic hydrogenation, these same alkadienes would be positioned within the spectrum of the fossil paraffinic waxes, with possible applications with respect to cleaning products, although these would be less interesting than the aforementioned ones.

It is toward this semisynthetic avenue of research that Mrs Casadevall's laboratory is currently orienting its activity, while at the same time pursuing the optimization of productivity by way of a thorough study of cultural parameters being carried out on a small photoreactor in continuous operation. An experimental setup on a pilot scale is currently being tested in conjunction with the ARBS's Cadarache CEN.

Other research teams have published on the subject, without, however, having reached the pilot stage. We cite here the principal ones: F. Wolf, Lawrence Berkely Laboratory, University of California; S. Aaronson, Queens College, City University of New York; L. W. Hillen in Australia; H. Zurer in Switzerland (Zurich).

Continuous Cultures

Continuous culture requires an equipment setup called the "cultivator." It consists of a flat, tubular system (tube diameter: 3 to 10 cm), that floats on the water and is transparent to light (made of glass or plastic). This is the "solar collector." Associated with it is a cellular culture aeration system, which circulates within it continuously. The design of the overall system is based on achieving a minimal volume of culture for a given area,

the sun being used to maximize the conversion efficiency. The LBS has the first cultivator of this type. With 180 meters of tubes, the volume of culture circulating is 130 liters. The solar absorbent area is 6 square meters. A computer-operated automatic control unit synchronizes the natural (day-night) alternation of luminosity with a biological rhythm based on nocturnal reproduction and diurnal cellular production. It is the small-scale prototype of a future pilot setup that will have an area of 100 m^2 and that is presently installed in a greenhouse. Another one will be installed in the open.

It is possible to increase the speed of reproduction of the cells and to orient the metabolism toward the desired production.

Cell divisions can be controlled by means of two techniques. The first consists of maintaining the cell concentration (using a turbidostat) at a value such that the rate of growth is maximized. The second consists of limiting, maintaining or accelerating cellular production, by way of limiting factors, such as the concentration of CO_2, of nitrogen, and the quantity of light, in accordance with the chemostat principle. However, the laws of "continuous culture," defined by Monod around 1950 in the realm of microbiology, cannot be applied to photosynthetic organisms, such as microalgae, without profound modifications, since the problems involved in their culture appear to be closer to those involved in that of the chrysanthemum than in that of the colon bacillus! Other methods of controlling cultures are in the experimental stage (see Table 2).

In addition, effort is being devoted to orienting the metabolic activity of cells, by controlling the values of the environmental parameters (light, temperature, pH, gaseous, mineral and organic composition). For example, a high luminous intensity associated with a high

$$\text{carbon (dissolved } CO_2) \,/\, \text{nitrogen (mineral)}$$

ratio, enables, in the case of certain algae (Porphyridium cruentum, Chlamydomonas sp.), the synthesis of polysaccharides (beginning with the Calvin cycle). A high osmotic pressure in the exterior environment induces the production of different molecules: Glycerol in the case of Dunaliella sp., sorbitol in that of Stichococcus sp., and mannitol in that of Platynomonas sp.

The continuous-culture technique raises problems that only basic research can resolve. The example of cell-growth limitation by rhythmic variations in luminous intensity (discontinuous natural lighting) demonstrates this. The mechanisms underlying the phasing of the cellular division cycles and the circadian cycles (day/night alternations) need to be understood. Essential in this respect is a knowledge of the particular role played by the pigments sensitive to low levels of luminous energy, such as the phytochromes.

One of the problems with this process is the temperature rise inherent in the optimal use of light in the thinner systems. To counteract this problem it is

desirable to use clones of microalgae, bacteria... that are resistant to high temperatures (thermophiles). At the LBS, automation provides an answer to this problem by more or less immersing the collector. The depth of immersion is a function of the difference in temperature of the culture and that of the exterior environment (air and water).

The problems posed by the harvesting of the exocellular products are presently under study. The hydrocarbons are now being extracted by skimming of the culture. The polysaccharides are precipitated in the supernatant obtained after centrifuging the Porphyridium cruentum culture. The latter excretes 50 percent of its total molecular dry weight in a sulfated polysaccharide of high molecular weight, consisting of units of xylose, lactose, galactose and sulfate. It could be a substitute for the carrageenins extracted from microalgae. Polysaccharide has a high market value: Currently around 40 to 80 francs/kg. By extrapolation, a 70-hectare solar collector would be needed to cover the 2,000 tons per year of carrageenins being produced domestically, the yield of the present prototype being 30 tons per hectare per year. In addition, the Porphyridium cruentum biomass could be commercialized through methanic or alcoholic fermentation, providing 5,000 m^3 of gas/year.

Immobilized cultures

The immobilization of entire cells on phototransparent substrates, permitting metabolic and gaseous exchanges, has advantages or its own. These stem from the creation of a specific physiological equilibrium, brought about by the limitation of nutrients in the culture liquid and by the lack of space in the supporting substrate. The cells being starved of nitrogen, the proteinic synthesis and the cellular divisions are slowed. In addition, upon saturation of the polyurethane sponge's pore volume, the cells can no longer reproduce, for lack of space. These colonies of immobilized cells acquire a stable metabolic equilibrium, "working" on a regular basis, continuously and over a long period of time (years) without undergoing alteration. Schematically, their activity becomes that of a polyenzymatic system that produces the metabolization of CO_2 as a sole metabolite, through, as in the continuous culture process, the controlling of the culture parameters (temperature, pH, etc). The ARBS's Solar Bioenergy Laboratory is particularly interested in this technique.

Immobilization offers decisive advantages over continuous culture:

--Limiting of the production of biomass strictly to the quantities needed for the fabrication of the biophotoreactor and for its renewal, which, as has been seen, can be very slow. Under these conditions and operating at maximum efficiency, the supplying of mineral elements is strictly proportioned to the quantity of products being photosynthesized: This increases the energy gain and diminishes the cost. In particular, in the manufacturing of a polysaccharide or of a hydrocarbon, the supplying of nitrogen, which represents 3/4 of the mineral energy requirement can be almost totally eliminated;

--The technique can take advantage of all the processes being developed by genetic engineering: The use of fixed or fluidized beds;

--The energy trade-off is improved: There is no longer a need for suspension, circulation or harvesting, manipulations that are indispensable to continuous-culture operation;

--Exocellular production is uninterruptedly eliminated from the cellular surface, minimizing the possibilities of the product itself inhibiting its own synthesis. In addition, the recent work of Brodelius (presently with the Zurich Polytechnic Institute) on immobilized cellular cultures has shown that it is possible to render permeable the plasmic membrane of the vegetal cells without destroying them, to free periodically the products of the intracellular metabolism, permitting a semi-continuous production of alkaloids.

LBS's Immobilized Cultures Technology

A photoreactor consisting of colonies of Porphyridium cruentum cells, immobibilized in the polyurethane sponge has been operating continuously at the LSB since April 1980. In it, these cells produce polysaccharides continuously. Other clones can secrete other polymers,consisting, for example, of galactose, rhamnose and xylose units. Botryococcus braunii has just recently been immobilized. For this species, the life span of the cells is 6 months, with preservation of their secretory activity.

Inclusion, a technique used by LBS for the fabrication of its photoreactors, requires a supporting substrate; Either a gel or a spongy structure. To obtain a spongy structure, one of the best-suited substances is polyurethane polymer. The polyurethane sponge is produced by the polymerization of this prepolymer (dimer).

At the appropriate moment, this preparation is mixed with a culture of microscopic algae. The culture liquor triggers the polymerization of the prepolymer with a release of CO_2, which produces a porous structure. By varying different factors (pH, temperature, etc), the physical characteristics of this sponge can be modified, particularly its porosity. The microalgae disperse in the pores as the mixture expands. When this expansion is complete, the sponge is removed from its mold and cut up into fragments which are then stacked in the photoreactor. The latter is made of a substance that is transparent to light and unalterable under the action of light, that is, either glass or plastic. At LBS, it is made of glass and has the form of a right-cylindrical column (height 2 m, diameter 0.04 m) and a volume of 2.5 liters. Its area of exposure to light is 0.25 m^2. A flow is then created in the photoreactor, consisting of a liquid whose composition is close to that of sea water and which circulates from bottom to top. For the first few days, the sponge is rinsed. During the formation of the sponge, a portion of the microalgae is destroyed. Following this purification stage, the remaining algae reproduce and recolonize the substrate. As the sponge becomes saturated, the circulating fluid gradually becomes impoverished of nitrogen. The exocellular production specific to each species of photosynthetic cell then starts.

In continuous operation, the biophotoreactor is subjected to uninterrupted lighting. The output produced by the system is carried to the upper end of the cylinder by the continuous flow that traverses the sponge. It is recovered and its volume automatically compensated by the arrival of a fluid at the lower end of the column. Certain system checks are made initially, others continuously. The position of the microalgae, their morphology and their ultrastructure are studied by means of scanning transmission microscopy. Photosynthetic O_2 emission is measured by a Clark electrode. The evolution of pigments in vivo is followed by spectrofluorimetry at -196°, or by means of laser-induced fluorescence. It is possible by this method to detect inactive pigments that are no longer associated with the pigment-protein complexes.

Immobilization, not of entire cells, but of certain cellular structures, such as chloroplasts and hydrogenases, is being developed in cooperation with the Enzymatic Technology Laboratory of Prof. D. Thomas at the UTC [expansion unknown] of Compiegne. The photosynthetic activity of the chloroplasts is prolonged under certain conditions of immobilization. By associating these chloroplasts with electron transport systems and with hydrogenases, hydrogen can be synthesized.

The ARBS is also working on immobilization of higher-order vegetable cells, especially Euophorbia characias (latex plant), which is rich in polyisoprenes, substances of the terpenes class. Haploid and diploid cellular clones are now being isolated by the culture of the epicotyl and anther tissues of this plant. Using these clones, their synthesis of polyisoprenes could be put to good use. They are polymers of mevalonic acid, which in turn is produced by polymerization of acetyl coenzyme A, a molecule that is common to both glucide and lipid metabolism. Each species of plant can, by way of metabolism of mevalonic acid, synthesize this or that given type of terpene. For example, saponins can be synthesized in this way by Dioscorea and Ginseng, rosemarinic acid by Coleus, Shikonine from Lithospernum... Before cultivating these naturally heterotrophic cells by immobilization, they must become photoautotrophic. This transformation is possible, since the genome of the cells carries the necessary information. A cell suspension, obtained by continuous tissue culture of these cultivated plants, uses normally a sugar as a source of carbon. By gradually reducing the concentration of this sugar in the culture medium and concurrently increasing the CO_2 level of the gaseous mixture circulating in the presence of light, the cellular suspension is rendered autotrophic. This was done in 1974 using the following plants: Asparagus, Spinach, Psoralea and Tobacco (C. Gudin, E. Peel, patent UK 1, 401, 681, 1975). The current research being conducted by LBS in this regard is aimed at putting cellular clones isolated from Euphorbia characias through this same evolutionary process.

Technicoeconomic Tickler File on the Development of Solar Biotechnologies

With very few exceptions[2], the development of microalgae production technologies has not escaped the socioeconomic pressures of the last decades. Research on unicellular-organism proteins (1950's to 1970's), in response to the world food crisis, left room for the treatment of liquid effluents, involving photosynthetic processes (1965's to 1980's), to cope with problems of pollution; and more recently, the oil shocks have brought about a reorientation of technologies toward the production of energy (1975-1982).

The present relative detente in the oil market is enabling a more rational orientation of applied research efforts, in view of the advances already achieved.

Reasonable expectations for the short term include at least the synthesizing of products of high specific added value, such as sulfated polysaccharides that can be substituted for carrageenin (50 francs/kg), and pigments and alkaloids (see Table 3), particularly if production can be rendered continuous and more efficient through the use of immobilized cells. To this end, it is highly important to create banks of microalgae capable of producing commercially interesting and immobilizable metabolites. The same is true for higher-order vegetal cells.

For the medium term, it is possible to envision the direct photosynthesis of products yielding energy or significant energy economies (hydrocarbon, ammonia). This time period should also include the regeneration of ATP (adenosine triphosphate), a bioenergy molecule that is indispensable to the development of certain, so-called second-generation, enzymatic reactors.

Then, one of the methods of producing hydrogen (photochemical, photoelectrochemical or photobiological) will become realizable, as will the photoreduction of CO_2 by means of chloroplasts in vitro, that is, the "cell-free agriculture" that is so dear to the heart C. Rebiez (University of Illinois) for the obtention of amylaceous substances and basic food proteins for world nutrition. With solar biotechnology, we are definitely on the right track to "short-circuiting" the high-order vegetables we have been cultivating until now and on which we have been entirely dependent.

Lastly, for the very long term, we can hope, together with Mr Guerin de Montgareuil, to produce each year in Southern France, with a net conversion efficiency of 7 percent, something like the equivalent of 1 tep per are! Now who does not have his or her one are of sunshine!

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2) The exceptions are certain East European countries (Bulgaria, Czechoslovakia) and Japan, which have in the past developed applicative research on products for cosmetic and pharmaceutical uses, and Israel, which is interested in the production of glycerol, an osmoregulatory product for use with Dunaliella, permitting growth under hypersaline conditions. To say nothing of the constant use being made of algae in basic research.

For more information:

--Societe Francaise de Microbiologie, section de microbiologie industrielle et de biotechnologie [French Microbiology Company, Industrial Microbiology and Biotechnology Section]: Annual synposium, 10-11 March 1983 (Technological University of Compiegne), on "Biotechnological Potentialities of Photosynthesis."

--Solar Energy R & D in the European Community (D. Reidel Publishing Company):

- Series D: Photochemical, photoelectrochemical and photobiological processes (Proceedings of the EC Contractors' Meeting held in Cadarache, 26-28 October 1981).
- Series E: Energy from Biomass; Vol 1 (1981); Vol 2 (1981); Vol 3 (1982). Second European Congress (Berlin 1982).

--Photosynthese, Biomasse, Energie. Cahiers AFEDES No. 6, 1981 [Photosynthesis, Biomass, Energy. AFEDES [expansion unknown] Journals No. 6, 1981]. Editions Thermique et Industrie [publisher].

--BIOMASSE ACTUALITES, Special Issue No. 3, May 1983: "Aquatic Vegetables."

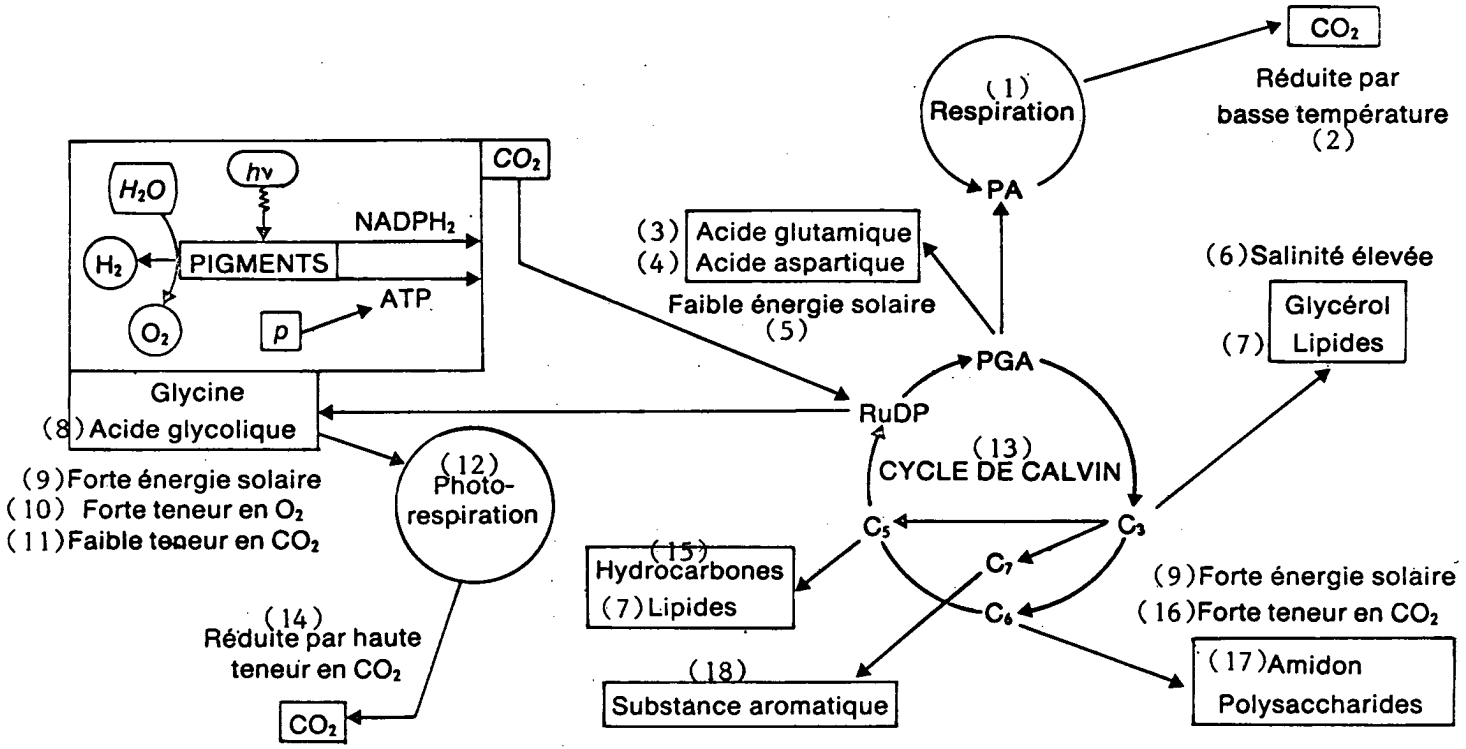
--Proceedings of the Subcontractors Review Meeting. Aquatic Species. SERI Program. U. S. Department of Energy 1981.

[Photos, charts and tables follow]:

Botryococcus braunii. Note the intracellular hydrocarbon inclusions. (Photo: CNRS).

Spongy structure of polyurethane foam. (Photo: CEA).

High-Value-Added or Energy-Generating Targets of Biotechnology



Source: "Energy from Biomass."

Key:

1. Respiration.
2. By low-temperature reduction.
3. Glutamic acid.
4. Aspartic acid.
5. Low-intensity solar energy.
6. High salinity.
7. Lipids
8. Glycolic acid.
9. High-intensity solar energy.
10. High O_2 content.
11. Low CO_2 content.
12. Photorespiration.
13. Calvin cycle.
14. High-CO_2 reduction.
15. Carbohydrates.
16. High CO_2 content.
17. Starch.
18. Aromatic substance.

Programs Financed by the European Communities Commission

(1 July 1980 - 30 June 1983)

(A) **Contractant**	(B) **Sujet**
C. Gudin *CEN Cadarache* (C)	Production et utilisation des algues *Porphyridium cruentum* (D)
Pr E. Casadevall *ENSCP* (E)	Production d'hydrocarbures par culture de l'algue *Botryococcus braunii* (F)
Pr C. Sironval *Université de Liège* (G) R. Noël, INIEX (H)	(I) 1) Culture de l'algue *B. braunii* à l'échelle pilote 2) Production de méthane par digestion anaérobie d'algues 3) Culture d'algues d'eau douce en eau de refroidissement de centrales nucléaires
Pr K. Wagener *Technical University Aachen* Pr G. Florenzano *Universieta di Firenze* (J)	(K) 1) Production de méthane « maryculture on land » 2) Culture massive ouverte d'algues en Italie du Sud utilisant de l'eau de mer enrichie en « boues activées »
Pr U. Croatto *CSARE (Italie)* (L)	Énergie de macroalgues dans le lagon de Venise (M)
Pr J.G. Morley *University of Nottingham*	Biomasse algale en offshore (N)

Key:

A. Contractor.
B. Scope.
C. CEN [Nuclear Studies Center], Cadarache.
D. Production and use of Porphyridium cruentum algae.
E. ENSCP [National Higher Institute of Chemistry, Paris].
F. Production of hydrocarbons by culture of the Botryococcus braunii alga.
G. University of Liege.
H. INIEX [expansion unknown].
I. 1) Culture of the Botryococcus braunii alga on a pilot scale.
   2) Production of methane by anaerobic digestion of algae.
   3) Culture of fresh-water algae in nuclear power plant cooling water.
J. University of Florence.
K. 1) Production of MCN [Maryculture on Land] methane.
   2) Large-scale open-basin culture of algae in Southern Italy, using sea water enriched with radioactive mud.
L. CSARE [expansion unknown].
M. Macroalgae energy in the Lagoon of Venice.
N. Offshore algal biomass.

Table 1 - Microalgae Bank

Espèces de microalgues (1)	Produit (2)	Localisation (3)
Dunaliella/Parva salinas *Stichococcus bacillaris* *Platynomonas suecica* *Monochrysis lutheri*	Glycérol Sorbitol Mannitol Cyclohexanetetrol	Intracellulaire (osmorégulation hypersalinité) (4)
Chlorococcum oelofaciens *Neochloris oelofaciens*	(5) Lipides (triglycérides)	Intracellulaire (faible teneur en azote) (6)
Phaeodactylum tricornutum	(5) Lipides	Intracellulaire (faible teneur en azote, lumière filtrée) (7)
Botryococcus braunii	(8) Hydrocarbures	(9) Extracellulaire
Porphyridium cruentum *Rhodella maculata* *Rhodosaurus marinus*	(10) Polysaccharides visqueux	(11) Extracellulaire (faible teneur en CO_2 lumière forte)
Chlamydomonas mexicana	(10) Polysaccharides visqueux	(9) Extracellulaire
Nostoc flosacquae *Anacystis nidulans*	Polysaccharides	(9) Extracellulaire
Stichochrysis sp.	Antibiotiques (12)	
Navicula ostreocola	Pigment naturel de l'huître (13)	
		(14)

Une banque de souches de microalgues est en cours de constitution au LBS. Elle rassemble un nombre croissant d'espèces productrices de substances telles que polysaccharides, hydrocarbures, lipides triglycériques, édulcorants.

Source: C. Gudin in "Energy from Biomass," 2nd Conference, published by A. Strub, P. Chartrier and G. Schleser.

Key:

1. Species of microalgae.
2. Product.
3. Locality.
4. Intracellular (osmoregulatory hypersalinity).
5. Lipids.
6. Intracellular (low nitrogen content).
7. Intracellular (low nitrogen content, filtered light).
8. Hydrocarbons.
9. Extracellular.
10. Viscous polysaccharides.
11. Extracellular (low CO_2 content, strong light).
12. Antibiotics.
13. Natural pigment of the oyster.
14. A bank of microalgae clones is being created at LBS. The number of species comprising it that yield substances such as polysaccharides, hydrocarbons, triglyceride lipids and sweeteners is growing.

Table 2 - Comparative Productivities of Microalgae Continuous-Culture Systems

	1. Bennmar (A) (Californie)	2. MCL (B) (Calabre)	3. ARBS (C) (Cadarache)
(D) Espèces cultivées	(E) Mélange d'espèces se succédant dans le temps		(F) Monospécifique
But (G)	Assainissement de l'eau (H)	Production biométhane (I)	Production produits haute valeur ajoutée (J)
Type de système (K)	Ouvert (L)	Ouvert (L)	Fermé (M)
Milieu de culture (N)	Eau douce (O)	Eau de mer (P)	Les deux (Q)
Épaisseur de la culture (R)	30 cm pour 30 g /m²/j, (S) [C] 0,1 g/l	30 cm pour 30 g/m²/j, (S) [C] 0,1 g/l	3 cm pour 30 g/m²/j, (T) [C] 1 g/l
Circulation d'eau pour la culture (U)	× 10	× 10	× 1
Régulation thermique (V)	Assurée par évaporation (W)	Assurée par évaporation (W)	Nécessite flottaison à profondeur réglable, ou aspersion ou souches thermophiles (X)
Productivité (Y) g/m²/jour (Z) t/ha/an (ZZ)	16,7 61	17,6 64	20,9 76

Key: [see facing page]

Key to Table 2 on facing page:

A. Microalgae culture system of Prof. Bennemar, California (United States).

B. MCL [Maryculture on Land] system, Prof. Wagener, Calabria (Italy).

C. Microalgae culture system of Profs. Villet and Gudin, ARBS, Cadarache (France).

D. Species cultivated.

E. Mixture of successive species over a period of time.

F. Monospecific.

G. Target.

H. Water purification.

I. Biomethane production.

J. Production of high-added-value products.

K. Type of system.

L. Open.

M. Closed.

N. Culture medium.

O. Fresh water.

P. Sea water.

Q. Both.

R. Thickness of culture.

S. 30 cm for 30 $g/m^2/j$, [ø] 0.1 g/l.

T. 3 cm for 30 $g/m^2/j$, [ø] 1 g/l.

U. Water circulation for the culture.

V. Thermal regulation.

W. By evaporation.

X. Requires adjustable depth of flotation, or sprinkling, or thermophile clones.

Y. Productivity.

Z. Grams/m^2/day.

ZZ. Tons/hectare/year.

Table 3 - High-Added-Value Molecules and Solar Biotechnology

(1) Produits	(2) Taille du marché mondial		(3) Superficie de biophoto-réacteur requise pour saturer ce marché	(4) % du poids sec accumulé par microalgue
	(5) MF	(6) t/an		
(7) Carraghénane	500	10 000	300 ha (8)	50 %
Sorbitol	500	60 000	2 000 ha (8)	50 %
Diogénine (9)	284	265	300 ha (8)	1 à 2 %
Thébaïne (10)	56	11	100 ha (8)	0,1 %
Atropine	37	346	3 ha (8)	0,5 %

Key:

1. Products.
2. Size of world market.
3. Biophotoreactor area required to saturate this market.
4. Percent of accumulated dry weight per microalga.
5. Million francs.
6. Tons/year.
7. Carrageenin.
8. Hectares.
9. Diogenin.
10. Thebaine.

9399
CSO: 3698/292

MARKETING HEAD SAYS AI MAY SEEK PARTNERS IN AMERICA, ASIA

Duesseldorf VDI NACHRICHTEN in German 20 Jan 84 p 1

[Text] Despite the current stagnation in the world aircraft market, Airbus Industry [AI] sees long-term growth here of at least 5 percent a year. This view was taken by Pierre Pailleret, Airbus marketing director, in a conversation with VDI NACHRICHTEN in Toulouse. He believes that the most important thing is to introduce the small Airbus A 320 into the market. At the same time, Pailleret spoke out in favor of launching a new long-range aircraft, the TA 11, in the not-too-distant future.

More than 2 years ago, AI in Toulouse made the decision to introduce the 150-seat A 320 into the market as the next aircraft. The hope thereby is to capture a substantial part of the market for about 3,000 aircraft at the beginning of the 1990's. For it is at this time that most airlines will have to replace their then obsolete Boeing 727's and 737's as well as their DC-9's.

Pierre Pailleret, AI marketing director in Toulouse, is certain that British Aerospace will also take part in the A-320 project, although there are still political reservations in London. Prime Minister Margaret Thatcher emphasized several times that one cannot afford a second failure like that of the supersonic aircraft Concorde.

Pailleret brushed aside rumors in the British press to the effect that Airbus would turn to Boeing with a cooperative offer if British Aerospace does not participate in the A 320: "We are in a war with Boeing for market shares. We cannot cooperate with them." These rumors are also being rejected by Boeing as nonsense.

Nevertheless, it is his opinion that Airbus will probably have to enter into cooperation with companies from outside Europe. Pailleret made that clear with the example of the long-range aircraft TA 11, the development of which is now being considered in Toulouse.

The essential new development in the case of a TA 11 would be the wing and, in the opinion of the marketing director, none of the Airbus partners can be expected, along with the risk of producing the A 320, to take on the

additional economic risk of developing the wing for the TA 11. Airbus must turn to competent partners outside of Europe that have sufficient financial strength and also the technical experience to undergo such a risk.

Here, according to Pailleret, one could consider McDonnell-Douglas as well as Japanese, Canadian or Australian companies. He does not even want to exclude cooperation with the PRC. To be sure, such international cooperation would bring with it tremendous technical and logistical problems, but these problems may be solved.

There is the conviction in Toulouse that expanding the number of products helps to insure the long-term survivability of the European aeronautical industry. "The smaller the offer," says Pierre Pailleret, "the more vulnerable a firm is."

New ways are also being found to sell aircraft and increase overall sales: Airbus has not entered into the market for used aircraft by buying the first models of type A 300 from established customers and replacing them with new A 310's. Then, following thorough modernization at a price of about $25 million, the old aircraft are to be unloaded in the U.S. market, mainly by selling to low-cost airlines. In this way, companies such as People's Express or Northeastern International Airways would also have access to aircraft with the most up-to-date technology.

At the moment, however, AI is still a long way away from making a profit. This could only occur if about 650 aircraft of the types A 300 and A 310 were sold. Through the end of last year, however, only 240 aircraft had been delivered.

9746
CSO: 3698/285

SUBCONTRACTORS, MARKET POTENTIAL FOR FOKKER 50, 100

Duesseldorf WIRTSCHAFTSWOCHE in German 10 Feb 84 pp 91, 94

[Article: "Fokker--Clever Combination"]

[Text] The Dutch aircraft builder Fokker wants to go it alone in the aircraft market against international competition. Two new programs are expected to assure full employment.

After two failed partnerships no one wanted to put any more faith in an independent future for the Fokker Royal Dutch Aircraft Factory. In the beginning of 1980 the firm marriage with the Bremen United Aircraft Engineering Plant (VFW) had split up after a long crisis and a betrothal with McDonnell Douglas announced in the spring of 1981 broke up after only a few months.

If in the first instance the dispute over marketing the (ultimately totally unsalable) 40-place short-range aircraft VFW 614 had led to divorce, the total stagnation prevailing in the aircraft market utterly destroyed lofty plans to launch the 150-place MDF-100 in transatlantic cooperation. In the end McDonnell's competitor Boeing turned out to be a clear winner.

It is true that for a long time Fokker has participated as a subcontractor in the airbus program by supplying some small components. But all those rumors have turned out to be premature which suggested that the isolated Dutchmen had no other recourse but to take refuge in the arms of the airbus consortium.

Already 2 years ago Fokker head Frans Swarttouw had confidently announced: "We are now concentrating on our current products, the F-27 and F-28, and we shall continue to work on the development of progressive transport planes."

In any case the twin-engine 40- to 50-place F-27 had made a good name for itself as the most sold turboprop airliner in the world. More than 750 aircraft of this "evergreen" have been sold since 1958 mainly in export markets. And also the profit threshold is already very close for the 60- to 80-place F-28, a two-engine jet for which there have been about 215 contracts.

However, these aged models are less and less able to meet the stiff demands of the airlines for higher cost efficiency. Although diminishing business forced a reduction in personnel by about 10 percent--today Fokker has barely

9,000 workers--the development staff has been untouched by this. At the end of last year the firm presented the results of their efforts: the new models Fokker 50 and Fokker 100.

The outwardly striking similarity to previous Fokker products certainly makes it clear that these are not entirely new developments. In fact the 50-place Fokker 50 is a modernized version of the proven F-27. But the new, very quiet propellors are driven by equally new fuel-conserving Pratt and Whitney propellor turbines.

The 100-place Fokker 100 is also based upon the predecessor model F-28. But the rejuvenation treatment has in this case been substantially more extensive: the fuselage has been lengthened, design changes in the wings reduce aerodynamic drag and contracts have already been given to Rolls-Royce for 100 of the new Tay engines.

In the case of these new Fokker programs the party also includes the three subcontractors of the previous model series: production of the Fokker 50 fuselages has been offered to Dassault while Short Brothers in Northern Ireland will build the wings of the Fokker 100. MBB, with proven experience, is responsible for fabricating the entire tail section.

Clever combination of old with new technology has also helped to save expense: at $300 million for both models the development cost has been relatively low. Forty-five percent of this sum has been provided by the Dutch Government in the form of refundable credits; bank guaranties cover an additional 45 percent and the remaining 10 percent is Fokker's investment of its own funds. Frans Swarttouw judges the prospects of economic success more optimistically than in the case of any previous aircraft: "With both models we shall be able to reach the profit threshold with only a very modest amount of production."

It is true that the Dutch reckon the total market for the small turboprop aircraft to be 1,250 airplanes but they must share this cake with the French-Italian ATR-42 and possibly also with the planned ATP of British Aerospace, although development of the latter is not yet fully under way. Also the Fokker 100 will have staff competition from the already mass-produced British Aerospace BAe 146. With the most recent contract for more than 20 machines purchased by Pacific Southwest Airlines the British have already made a considerable penetration into the U.S. market.

But the market potential for these small 100-place aircraft is estimated to be at least 750 machines: "Today's airliners are for the most part too big for the limited passenger flow on many short and medium ranges" in the view of one Fokker salesman. In fact the airlines are increasingly looking for small aircraft below the size class of the Boeing 737 or McDonnell Douglas MD-80, alias DC-9 Super 80.

It is an open secret that, for example, Swissair has already shown strong interest in the Fokker 100 in order to be able to serve thin European routes more economically. And the Dutchmen also believe that they can supply both

of the new aircraft very rapidly--the turboprop Fokker 50 will be in the market by the middle of 1986, and the Fokker 100 barely 1 year later. In any case they want to prove through this double program that they can continue to stand on their own feet as "short-range aircraft specialists"--to cite their advertising slogan.

8008
CSO: 3698/290

BRIEFS

FIFTH POSSIBLE BUYER FOR A-320--Are these just more rumors? Can we, on the other hand, finally speak of a more accurate timetable? The launching of the small Airbus A-320 is again in the air. The British decision on the financing of this program is in fact to be announced this week. And, unless there is a failure this time, a meeting will in all likelihood be called at the end of the month of the 4 ministers involved: Charles Fiterman and his British, West German and Spanish colleagues. Lastly, under the heading of good news, a fifth company has promised to purchase the future 150-seat plane for which 150 aircraft orders or purchase options have been made. Airbus Industrie states that it is now ready. Commercially speaking, results obtained have reached a level sufficient to justify immediate launching, according to the European consortium. It has, in fact, been announced that after Air France, Air Inter, British Caledonian and the Yugoslav company Inex Caledonian, a fifth customer whose name has not as yet been made public, has placed 4 firm orders and taken an option for 3 or 4 others. Which brings to approximately 100--95 or 96 to be exact--the number of A-320's ordered or on which options to purchase have been taken. /Excerpts/ /Paris L'HUMANITE in French 1 Feb 84 p 16/

9436
CSO: 3698/279

SIEMENS TO HIRE 150 MICROELECTRONICS RESEARCHERS

Vienna PROFIL in German 6 Feb 84 p 26

[Article by Elisa Gregor: "Microcircuits Custom Designed--Siemens Is Hiring Researchers: 150 All at Once"]

[Text] It is a summons to battle with the Japanese and the Americans: "Permeation of products and systems by microelectronics," declares Prof Dr Karl Beckurts, member of the Board of Siemens, Inc, and head of the Central Department of Technology, "is today the most important prerequisite for the competitive competence of such products on the world market."

Siemens wants to get into that market on a worldwide scale and is therefore striking some heavy blows.

With tight secrecy.

The central research division in Munich, occupied at the moment by 120 scientists, is at the present time looking for an additional 150. Actually Siemens is not looking for these highly trained workers through classified ads but directly at the universities; in particular also in Austria.

The intensified call for physicists and electronics specialists is not haphazard: by 1988 just the demand for integrated circuits will increase from a figure of about 119 billion schillings today up to about 420 billion schillings. Among investment properties, the fraction of those products which contain microelectronics as components has risen in the FRG from 12 percent (1977) to a good 25 percent (1981); among consumer goods the figure has increased from 4 to 9.

Most microelectronic circuits are still standard designs.

But in the coming years Siemens intends to cut down on standard microelectronics and increasingly produce "tailor-made, rapidly and economically available integrated circuits" (Beckurts). In the future a tailor-made chip will not have diverse circuits for diverse fields of application which it does not need but it will be preprogrammed for a special domain.

Thus, for example, if a chip were capable of performing all computational functions while being required, however, only for root extraction these "vehicular" functions will not be carried along: addition, subtraction, division and multiplication will be omitted.

As a project goal the company management hopes in the next 4 years to have microelectronics in 70 percent of their devices and systems rather than the previous 50 percent.

Skeptics consider that to be wishful thinking. They object that a tailor-made chip can increase the cost of a device so much that the buyer would rather have the standard design.

And there are also divergent opinions regarding the dramatic stocking up in research personnel.

Opponents of Siemens contend that that concern has a lot of catching up to do in microelectronics relative to the United States and Japan and is quite simply forced to step on the gas.

But friends of Siemens claim that the company's management has recognized the importance of microelectronics as a key technology of the future and are going on the offensive with large research budgets.

In the research division in Munich people are optimistic: "We respect the Japanese and the Americans," says Dr Bernhard Nottbeck, speaking for Prof Beckurts, "but it is our feeling that we are quite capable of keeping up with them."

8008
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SCIENTIFIC AND INDUSTRIAL POLICY

DENMARK PROPOSES KR 1.5 BILLION TECHNOLOGY DEVELOPMENT PROGRAM

Copenhagen BERLINGSKE TIDENDE in Danish 30 Jan 84 p 9

[Article by Ib Worning, director, Technology Council chairman: "The Technology of New Opportunities"]

[Text] The Technology Council has submitted a proposal to the industry minister that the State use 1.5 billion kroner over four years to help Danish industry convert to new high technology, primarily, information technology. The council's chairman talks about the proposal and its background.

"There is a horror of and resistance against the new technology, which I often encounter. This must be respected. I can well understand that many think that the new world with computers and microprocessors feels alien, something which is difficult to master--and which, on top of this, threatens one's job."

"But we should play down the entry of electronics and regard it more as an adjustment and changeover problem than as something which will completely change and revolutionize life at work. Computers and new technology are something which we all with a little help and education can learn to work with and master."

Swedish Future Development Minister and Vice-Prime-Minister Ingvar Carlsson spoke thus when last week he talked about Sweden and employment in the future.

He said without reservation that "if Sweden is to have full employment and remain a welfare society we must put our stakes on technology." And he reported that the Swedish government will now initiate a gigantic adult education program which will familiarize tens of thousands of Swedes with the new computer technology. The government will offer the actively employed part of the population, and especially the poorly educated, courses of three months duration.

At the same time the Swedes are banking on a 5-year microelectronics program, on computer instruction in primary school and updating courses for teachers and is considering a wideband network based on optical fiber cables.

In several countries, including Japan, France and Great Britain, large computer and electronics programs are being carried out, and there are expectations that the information technology industry itself will grow to be in 1990 the largest isolated manufacturing sector with annual sales of about 600 billion dollars, and that in Western Europe this industry will employ upward of 50 percent of the labor force.

Now, of course, it is not certain that these expectations will come true. Assessments of this kind of course of development have overshot the mark before. It took a longer time to achieve the expected results than foreseen. But even with these reservations there is no doubt that we are at the beginning of a very fast running technological development in which it is vital for Denmark to avoid falling behind if we are to maintain our relatively high welfare level.

They are also aware of this in political quarters. As early as at the end of October Industry Minister Ib Stetter at a conference at Eigtved's Warehouse in Copenhagen announced that a technological development program is being worked on which, for one thing, includes a national program for promoting and applying information technology.

Studies in other countries indicate that 30 to 50 percent of their industry is threatened with bankruptcy as a result of declining competitiveness and share of the market, which can be explained directly by the insufficient use of information technology, he said, and added: "There is no reason to believe that the situation here at home is essentially different from this. We must not fall into this trap, and therefore the government intends to gamble heavily on this field. We are doing this not least because information technology offers our many smaller businesses new opportunities in the direction of flexibility and rapid adaptation to the market, which is precisely one of their best competition parameters."

Later the prime minister made a statement along this line, and in December the Technology Council--inspired by the Industry Ministry--presented its assessment of the situation and its proposals for the necessary measures in the form of a comprehensive technological development program.

It is a question of a conspicuously big program according to Denmark's scale, but not in comparison with the stakes being placed on the field in other countries.

The program will run over four years and it is estimated that all together it will cost the State about 1.5 billion kroner, 270 million of this the first year. Added to this is estimated cofinancing from industry of 500 to 600 million kroner.

The purpose of the program is for the State by a number of different measures to help the changeover to the use of new high technology--which Danish businesses under any circumstances will have to make if they are to survive--to be able to happen as quickly and efficiently as possible so that the community will get the maximum benefit from the changeover, measured in terms of

employment and the balance of payments. In addition, so that the changeover can take place with the maximum influence of the contributors.

There is reason to emphasize that although the development program is big it represents only a part--i.e., the technological industry-oriented part--of the contribution which must be made. Another essential part, a comprehensive program of education which is to educate and retrain the Danish labor force to be able to handle the new technology, is not included in the Technology Council's initiative. On the other hand, the council has pointed to the need for this and in addition has supplied information to--and gotten information from--the authorities in question.

Before a discussion of the technological development program which was presented to the industry minister in December, a few words about its background.

For many years technological development has been in favor of mass production and large businesses and thereby to the prejudice of large parts of Danish industry, which, viewed internationally, consists almost exclusively of smaller businesses.

But this situation has been changed by microelectronics and information technology: Today the technology favors an industry like the Danish, because smaller businesses now at relatively modest expense can obtain the advantages of the "big ones," both as far as administration, acquisition of knowledge, product development and production are concerned. And without firms losing in flexibility and working environment.

Therefore, we in Danish industry have especially good opportunities if we understand how to utilize the new technology.

It is not just a question of developing and selling information technology products themselves, although this can become a very important industry for Denmark. In the Technology Council's opinion it is even more significant that the new technology can build renewed competitive strength in leading areas of Danish industry which up to now have been threatened by development. This relates to businesses within industries like the iron and metals industry, electronics, wood products, textiles, the food industry, the chemicals industry, etc.

It is /both/ [in italics] the improved possibility of survival for firms with an estimated 140,000 jobs in danger /and/ [in italics] development of a really Danish information technology industry with other thousands of new jobs which the technological development program is to promote.

There is no doubt that a changeover to the use of the new technology would take place in Danish industry without the program. But it is the Technology Council's distinct opinion that it would take place more slowly, not least in small businesses, and that the cost in the form of lost competitiveness among those which do not manage the changeover would be high.

In the view of the Technology Council technological development will give Danish firms a chance. And the council regards it as vital that the State promote the exploitation of this chance in the interest of the entire community.

The program itself consists of six subprograms: Three which aim directly at better exploitation of information technology's opportunities out in firms; a fourth which will make efficient the bringing home from abroad of knowledge regarding new technology; and a fifth which is to finance the procurement of advanced systems and equipment for research, development, technological services, and education. As well as a sixth program which is to evaluate the consequences of the new technology.

Of the three decided-on information technology programs which will monopolize by far the largest part of the development program's money, one concerns promoting the development of information technology as such, a second is to promote the use of the new technology in production processes, and a third its use in products.

The funds are, for one thing, subsidies for development projects of various types in correlation with consumers, researchers and producers, together with the development of demonstration systems where firms can come and see how the new technology can be used.

As stated, the objective of the sixth subprogram is to throw light on the more far-ranging and broader social consequences of introducing information technology to the extent which will be necessary. Five million kroner in each of the four years have been earmarked for this. That is, a total of 20 million kroner.

There will without doubt be a discussion of to what extent this amount is sufficient. Not least, viewed in relation to the 1.5 billion kroner which the entire development program will cost. To this it is to be said that the Technology Council is quite clearly disposed toward there being a total assessment of the consequences of introducing information technology. Whether 20 million kroner is the proper amount can be discussed; but in the council's best judgement this represents the contribution which can be made in the area today with the research resources which are available.

It can, of course, also be discussed whether it is proper to gamble so large an amount as 1.5 billion kroner over four years on precisely information technology. There are certainly other promising fields. Bioengineering, for example.

The Technology Council's attitude is in part that information technology in the council's opinion is "riper" than any other of the remaining significant technical fields. And in part, information technology is of unique far-ranging importance because in addition to being an independent discipline it is also a "tool discipline," so to speak, for all other fields. It is playing and will play a significant role in all industries--in the bioengineering industry, too.

At the same time the council wants to make a point of the fact that it does not want development to stop in promising technological fields and to channel all resources into information technology.

The effort in the form of the technological development program is to take place with an /extraordinary/ [in italics] government effort. In addition to this, there must be room for supporting other promising fields as required, in the normal manner, and within the ordinary appropriations of the technological industry promotion arrangements.

In addition, it is not the idea that new agencies are to be established in order to carry out the development program. It can be carried out under the jurisdiction of the Industry ministry under the Technology Administration's arrangements, primarily, the Technology Council, the Development Foundation, the EDP Foundation and the State Subsidy for Product Development arrangement. However, it will be necessary to establish a special program committee which can be in charge of the practical planning and implementation.

It has already been stated what significance the program will have for industry's competitiveness. On the basis of studies here at home and in other countries, it can be estimated that about 40 percent of Danish industry within the next 10 years or so will have to use information technology in products and production processes in order to avoid being ousted by the competition and having to close. This corresponds roughly to saying that the keeping of about 140,000 jobs in industry will be dependent on how successful the changeover to new technology is. Practically speaking, the utilization of information technology will affect employment in industry in two different ways. On one hand it will mean that the same amount can be produced with fewer contributors, who, on the other hand, will not lose their jobs because the firm has to close. On the other hand, it will at the same time increase competitiveness and thereby provide an opportunity for increased production and work for more. It is my personal opinion that the last-cited effect will be the dominant one.

However, decisive for the total industrial employment effect will be the fact that information technology will provide an opportunity for totally new production processes, both for information technology products per se and for new products which utilize information technology within instrument making, machine building and equipment making production, as well as an opportunity for the establishment of a new software industry.

A further very promising prospect is in the establishment of a number of new services. A constantly competitive industry will, that is, demand a number of new high-technology industry-oriented services which information technology will provide an opportunity for and which in addition can become the strongest growing sector of industry with regard to employment. This relates to services--not least in the private sector--concerning, for example, communications, research and development, management and information in the broad sense. In addition, there will be new services within the health, culture and leisure time sector.

Without a competitive industry and the service industries associated with it there will be no basis either in the shorter or longer term for employing the many unemployed. Therefore, the proposed development program is a necessary element in fighting unemployment and in the effort to employ not least the many young people who already now and in years to come will enter the job market.

The Technology Council published its development program in December, just when the Folketing committee had been dismissed. Now the situation has been clarified more and it is our hope that the politicians will look at it quickly. It is important to get started. Not because the big amounts must be drawn immediately, but so that the necessary planning effort can get started so that the program can be clarified and detailed within an established appropriations framework. We must avoid Danish industry's falling behind, but, on the contrary, exploit the special opportunity lying in new information technology. For many firms--and for many jobs--putting high technology to use quickly and properly will be a question of survival.

8985
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SCIENTIFIC AND INDUSTRIAL POLICY

FRG SEEKS WAYS TO PROMOTE VENTURE CAPITAL INVESTMENT

Duesseldorf VDI NACHRICHTEN in German 10 Feb 84 p 5

[Article: "Risk Capital Is Being Reexamined--A Reprimand for the Banks--Praise for the VDI Technology Center"]

[Text] The supply of the German economy, in particular, small technology-oriented enterprises, with risk capital has become an important theme of research policy and economic policy in Bonn. A study conducted by the German Federal Ministry of Economics has come to the conclusion that there does not exist a general lack of potential risk capital but that the funds are simply not being adequately invested. The Economic and Social Science Institute of the German Association of Trade Unions is even more emphatically of this opinion: the statistical data of the German National Bank [Bundesbank] has led to erroneous conclusions. In the national economy it is impossible to establish a want of capital suitable for investment.

The economic policymakers of the coalition and of the SPD share the view that capital flows have been misdirected into projects which are lucrative but are of doubtful value for the entire economy, such as write-off companies or construction projects. Nevertheless, they draw different conclusions from this. According to an information-gathering tour by representatives of the Economic Committee of the Bundestag in the United States there has been a strengthening of the opinion that the risk capital instrument could make an important contribution to the establishment of young enterprises and their entrance into the marketplace up to the stage when these enterprises are ready for listing on the stock exchange. Of course, this is opposed by a conservative mentality on the part of German capital investors.

The coalition fractions CDU/CSU and FDP want to combat these attitudes primarily through tax incentives. They have introduced into the Bundestag a bill for the "promotion of the formation of risk capital." This bill emphasizes the great importance of small and medium enterprises, especially of technology-oriented new companies for economic restructuring, for the preservation of jobs and their increase and for the international competitive competence of the FRG. The 14 points which they propose as yardsticks to be used by the federal government should be useful in enlivening the national economic process of innovation.

The admission requirements which small and medium enterprises must meet to be listed on the stock exchange should be eased through a second stock exchange corresponding to the proposals made by a commission consisting of stock exchange experts or through reorganization of the regulated open market. Also stock-issuing enterprises which are not banks should receive the right to stock exchange listing. Moreover, it should be easier to transfer shares in limited liability companies and limited partnerships; moreover, the financial counseling should become a constituent of the guidelines of the German Federal Ministry of Economics with regard to the promotion of enterprise-counseling services. Investment trusts and insurance enterprises should be able to secure participation in enterprises which are not traded on the stock exchange. The law governing investment trusts and the law covering insurance supervision would in addition have to be amplified and their investment principles should be modified to the extent of establishing a quantitative limit to the acquisition of shares in individual enterprises.

Within the area of taxation the coalition fractions are contemplating the elimination of the company turnover tax and possibly also the stock market transfer tax; they are also considering making fully deductible the costs for the board of directors in profit appraisal; they are also contemplating a 2-year extension of the forward-carried debit balance in the case of young enterprises; they are also considering a guarantee of a maximal tax concession in accordance with Section 6b of the Income Tax Law.

The SPD attaches less importance to working with tax concessions. Instead, they support the idea of eliminating the tax advantages for construction projects and write-off companies which compete with risk capital investment. With the tax proposals of the coalition they consider that it would be impossible to divert capital flows. A hearing of experts has strengthened the SPD in the emphasis which it attaches to the psychological problem of deficient risk financing. They consider that among entrepreneurs, managers, bankers and owners of capital there prevails a "full-till mentality."

In the resume of their hearing the SPD representatives Wolfgang Roth and Dr Uwe Jens enter expressly upon the topic of venture capital for young enterprises as a "special theme." Here they maintain there is a lack of interim financing between the establishment of an enterprise and the time when it is ready to appear on the market. Apart from only a few exceptions they consider that here the banks have failed, that they had not organized the requisite technical expertise to examine planned enterprises relative to their prospects of market success. As an example of such expert aid Roth mentioned to the press the VDI Technology Center. With regard to the much-criticized German Risk-Financing Company (WFG) he was of the opinion that its long response time has all too clearly shown the mentality of the banks. He said that the WFG is more conscious of the problems but is still lagging far behind expectations.

8008
CSO: 3698/289

SCIENTIFIC AND INDUSTRIAL POLICY

SWEDISH TECHNICAL BOARD PROMOTES OWN 'SILICON VALLEY'

Stockholm TEKNIK I TIDEN in Swedish Winter 1984 p 3

[Article: "Western Sweden Gets Own Electronics Center"]

[Text] One company is taking root in the Partille clay and hopes to grow there. At the same time, western Sweden is getting an electronics center with extremely good chances for expansion.

Early in the year, SiTek will leave Chalmers and move out to the same building in which Selcom already is located. These two companies have cooperated closely since they were started (Selcom in 1970 and SiTek around New Year's Day 1977).

Is this another attempt to create a Silicon Valley on Swedish soil? Lars-Erik Lindholm, in any case, believes there is reason to compare it to the American model near San Fransisco.

"They have their Golden Gate Bridge and we have our Alvsborg Bridge. There a number of electronics companies have moved together and the same is happening here. The Americans are operating in a high-risk earthquake area and we are moving to an area in which landslides are a potential problem."

On this last point, however, experts in Partille and geological tests have been reassuring. The danger of landslides is extremely small.

"In any event, this is an example of a successful investment on the part of STU (Swedish Board for Technical Development). It has provided both new industries and new jobs. In addition, export sales are significant," Lars-Erik Lindholm said.

STU has been in the picture with respect to both SiTek and Selcom. Several years ago SiTek purchased an ion implantation machine that is used to produce detectors. It was financed half by STU and the rest by the company itself.

SiTek will move the machine to its new location. So far production has been extremely limited. The machine has a capacity of several thousand detectors per week.

The rest of the equipment SiTek needs may be purchased abroad.

"We looked at a semiconductor factory in Scotland we are interested in that will be closed. We are considering disassembling it and bringing the parts back here."

With regard to employment, SiTek has already doubled since Rang Invest became the new owner. It is estimated that the four employees with the company last September will increase to 15 or 20 by early 1984. The employment picture at Selcom gives a good indication of the possibility for new jobs.

Selcom started in 1970. Today it has 40 employees. Within several years the two companies could employ several hundred people.

9336
CSO: 3698/272

SWEDEN INVESTS 700 MILLION KR IN MICROELECTRONICS PROGRAM

Stockholm TEKNIK I TEDEN in Swedish Winter 1984 p 4

[Article by Lennart Lindeborg and Bjorn Englund, Swedish Board for Technical Development]

[Text] The electronics industry in Sweden now has a volume of about 22 billion kronor. The industry is expansive and profitable with an above-average growth rate. It includes, in addition to a few large, dominant companies, a number of small and medium-size companies, both established and recently started. The industry's goods meet the needs of the market because it has successfully implemented electronics and data technology through a combination of technology and software in its products and systems that is sound from an engineering standpoint.

What is the role of STU (Swedish Board for Technical Development) in the development of the electronics and data industry?

One of the main tasks of STU is to support the development of expertise in the base technologies involved in the collection, transmission, processing, storage, and representation of information, known by the collective term of "information technology."

This involves systems-oriented methods and software for information processing, the processing of pictures, signals, and speech, and measurement and control technology, as well as pure data technology, electronics, optics, and electro-optics.

Double Motive

These efforts are motivated not only by the needs of what we now call the electronics and data industry, but also by a number of applied fields such as design and production systems in manufacturing, the transport system, off-shore drilling, public data systems, etc., all of which may be seen as markets for the electronics industry.

Another important role for STU with regard to the electronics industry is support for product development. In this field the number of innovative

projects involving electronics has increased in recent years.

STU's main target groups for this support are small and medium-size companies and inventors, but innovative projects at our technical universities also are important.

Broad Effort Needed

In its proposal to the government for the next 3-year period, STU stressed the importance of a broad effort throughout the field of information technology.

As part of this effort, STU made a special proposal in the spring of 1983 for a National Microelectronics Program (NMP). The government's NMP proposal is now in parliament.

It is important to point out that the program does not intend to make Swedish industry self-sufficient in the area of standard electronics components.

Instead, the goal is to increase the ability of the electronics industry to design and produce rapidly and effectively critical electronic components, primarily highly complex and fast integrated circuits made to order for a specific customer.

Reason For Increased Production

Thus, the program could lay the foundation for the increased production and export of systems containing more domestically developed electronics. This also would help develop a competitive components industry for the future.

Some of the reasons for the proposed program are the following;

These components are the building blocks for systems developed in this country ("just as important as gear wheels in the mechanical industry");

More and more of the added value of systems results from the electronic components. Sufficient profit margins do not result simply from producing the mechanical parts of systems;

The properties of the components usually are vital to the design and performance of the system;

Too much dependence on foreign producers of made-to-order circuits carries the risk that valuable knowledge at the systems level could be revealed and later used by these producers, for example in the form of standard circuits;

Rapid market growth;

The possibility of developing and manufacturing new types of components and circuits is a source of innovation;

The use of made-to-order integrated circuits is an effective way to protect

(conceal) designs from competitors;

Export restrictions in other countries can make it difficult or impossible to utilize advanced components in Swedish products.

One half from the state and the other half from the industry.

Improved Training

The subprogram Continued Training is designed to improve the training of the growing number of technicians in Swedish industry who will help expand the use of microelectronics during the coming years.

At the university and high school levels the UHA (Office of Swedish Higher Education) and SO (Swedish Board of Education) are studying and planning educational programs.

While these programs are being developed, STU and SIND will arrange training for circuit designers in the industry and for high school teachers.

An effort also will made to spread information about how microcircuits are made to companies other than the very largest.

Scientific Base

The subprogram Leading Edge Technology Research is designed to create a scientific base for expansion within the Swedish microelectronics industry through basic research.

Here, as in many other areas, we in Sweden are extremely dependent on the scientific exchange with other countries.

In order to do this, we must be prominent in some of the scientific disciplines on which microelectronics is based.

NFR (Research Council for the Natural Sciences) has prepared a report on upgrading Swedish semiconductor research. The original idea was to create a national semiconductor laboratory.

This idea has been abandoned. Instead, it was proposed that basic research in the semiconductor field be conducted at several institutions of higher learning and that it concentrate on three areas in which we already are involved in world-class research.

One of the important tasks NFR will be responsible for is the procurement of modern equipment.

Goal-Oriented Research

The subprogram Development Tools also involves research, but of a goal-oriented type.

The goal is to expand the technical expertise the industry needs in the long run and to lay a foundation for the development of new products and new applications in the field of microelectronics.

This subprogram is a continuation and refinement of the program to develop expertise started by STU in the late seventies.

It involves interesting combinations of optics and electronics, special circuits of silicon and gallium arsenide, ultra-small structures, and certain types of components, sensors, and indicators.

Industrial Designs

The subprogram Technology Purchasing is designed to create resources and develop methods of industrial design and production of microelectronics for a large group of Swedish companies to use in the future.

The goal is to carry out eight projects with cooperation and joint financing between the companies and government agencies.

STU, the Defense Materiel Command, other government agencies, and companies will act as "purchaser." The "suppliers" will be large and small groups of companies and research institutes.

The project is intended to produce:

Production resources so that industrial customers will be able to receive finished circuits in a short period of time;

Systems for the rapid and reliable design and control of circuits and systems;

Technology for producing high-performance circuits for demanding applications in systems;

Expertise for producing the technology for the next generation of electronics and optics combinations based, for example, on gallium arsenide.

Coordinated

Those responsible for the various subprograms of NMP will make a major effort to coordinate all the parts.

Every effort must be made to achieve the desired results, namely a "boost" for

the large sector of Swedish industry that will be dependent on microelectronics within several years.

These expectations and the fact that the government is investing in NMP during a time of tight finances make this a real challenge for everyone involved.

Supplemental training measures
"CONTINUED TRAINING"
20 Million Kronor

Basic research program (NHF)
"LEADING-EDGE TECHNOLOGY RESEARCH"
60 Million Kronor

Technical research program (STU)
"DEVELOPMENT TOOLS"
315 Million Kronor

Industrial development
"TECHNOLOGY PURCHASING"
330 Million Kronor (half from the state, half from the industry)

9336
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RISK CAPITAL INVESTMENT IN SWEDEN, FRG, UK, FRANCE

Stockholm TEKNIK I TIDEN in Swedish Winter 1984 pp 22-23

[Article: "Venture Firms Already Exist with 450 Million"]

[Excerpts] The risk of losing money on new projects is great, but the probability of making money is even greater. This is the reason for the growing interest in Sweden, especially among companies, to become involved in promising new companies by supplying risk capital and by purchasing a minority interest in order to guarantee the necessary capital base.

This was stated by chief engineer Peter Jorgensen of STU (Swedish Board for Technical Development) at a recent meeting in Goteborg on various venture-capital markets.

Conditions for such a market in Sweden have improved considerably as a result of several recent changes in the law:

Reduced double taxation: 70 percent of the dividends may be deducted, up to a maximum of 700,000 kronor or 15 percent of the working capital;

Changed property tax: active companies not listed on the stock exchange are assessed at 30 percent of their material value;

Government allocations for investment in growing industries: subsidies for interest payments during the 1982/1983 fiscal year amounted to 3.5 million kronor, while 25 million kronor in guarantees were provided;

Fund managers have been given the right to act as "market makers" outside the Stockholm Stock Exchange, which has resulted in the so-called OTC (over-the-counter) market.

"These changes, and perhaps especially the appearance of the OTC market, are vital to the continued development of a venture-capital market in Sweden," Peter Jorgensen said.

The development of the risk-capital market may best be described as an avalanche.

Venture-capital companies with a capital on the order of 450 million kronor

have already been formed.

Insurance companies, the 4th AP Fund (National Pension Insurance Fund), and investment companies have been particularly active. The latter are also extremely active in placing risk capital outside venture-capital companies.

Rapid Development

"Today there is at least 0.5 billion and probably over 1 billion kronor available as risk capital for promising new companies in Sweden."

Examples of companies that have receive such risk capital are two new pharmaceutical companies, a robot project that has received several million, a training concept that will be sold in the United States, and a new airline in central Sweden.

"All this rapid development disproves the assertion that there is no interest in Sweden in investing money in risky new projects," Peter Jorgensen said.

But there are certain criteria that even a venture-capital company must meet. It must be able to find key people, often people with so-called entrepreneurial skills, for the company it is investing in. It also must be financially sound and prepared for long-term investments. American studies show that losses come after 2 or 3 years, while high profits come only after 7 or 8 years.

Long-Term Perspective

"This means that an investor who is not prepared to stand by his risk-capital investment for 5 years, but gets out when losses occur, not only risks losing all his capital, but also risks destroying the new company he has financed," said Peter Jorgensen, who also outlined two scenarios for the future. The pessimistic scenario is as follows:

A weak capital base and weak leadership force several venture-capital companies into bankruptcy;

The real estate market is dominant among portfolio companies;

Venture-capital companies force businesses to expand rapidly, with bankruptcies as a result;

Many private individuals invest in new companies and lose money;

New laws that increase regulation are passed.

The optimistic scenario is as follows:

A large number of competent investors in new companies appear on the scene;

New internationally oriented venture-capital companies are started;

Venture-capital companies increase their management competence and their capital base;

A large number of interesting business ideas are generated;

Media coverage increases;

Many new companies are formed;

New forms of financing are introduced;

New investors increase their activity--insurance companies, investment companies, and large manufacturing companies.

The Stock Market

Of course, another necessary condition for a good venture-capital market is the availability of buyers to provide capital gains, i.e. an active stock market. Such a market exists in the United States.

Swedish interests also are present in the United States today in venture-capital funds. These interests include Investeringsbanken, Investor, Berema (subsidiary of Copco), and Alfa Laval. Their goals are to learn, to discover new techniques that can be imported to Sweden, and also, of course, to make money.

There is no venture-capital market on the American model in West Germany, according to attache Bo Cavell, but there are some support programs and risk-capital institutes. One example of the latter is WFG, a private company started in 1975 by 28 West German bankers. WFG has government guarantees behind it and eventually will become profitable. It is especially interested in small and medium-size companies that are investing in technical innovations. WFG requires that finished prototypes be available and it invests in production equipment. WFG becomes a minority owner for a certain predetermined time and the original owners have the option of purchasing WFG's share of the company at a later date.

West Germany also has various support programs, some of which are remnants of the post-war period, which provide favorable loans to people who want to start their own business.

Science Parks

According to a study, about 250 million pounds were available in Great Britain last June as venture capital for the many new small businesses in the high technology field, attache Gillis Een stated in his report.

The British government is also involved. The National Research and Development Corporation, which is part of the Trade and Industry Ministry, was formed in 1967 with a capital of 50 million pounds to support inventions made at the universities. Today its activity has expanded to include innovations and

innovative companies in general. Foreign inventions are also included. NRDC (National Research and Development Corporation) has done quite well. By 1979 it had payed back the initial capital to the state and it is now self-financed.

The Bank of England and British commercial banks together (15 and 85 percent, respectively) founded the organization Investors in Industry. A division of this organization, Industrial and Commercial Finance Corporation (ICFC) invests in innovative companies by purchasing minority holdings. ICFC also has at its disposal a staff of specialists of various types who can assist the companies the organization invests in.

On the private side, there are organizations such as PA Technology, a division of the PA group, which locates risk capital and tries to attract it to goal-oriented research and development programs, most of which are conducted in the laboratories of PA Technology. It should be noted that PA Technology also seeks venture capital in Sweden.

Several British universities have so-called science parks with small industrial plants for research, development, and small-scale production. Some of them, for example the one in Birmingham, can also provide financial help. Cambridge also has such a park, which includes the Swedish company LKB Biochrome Ltd, which is part of the Incentive group.

Tax Break In France

Many people in France look with envy at the American venture-capital market, according to attache Lennart Rohlin in Paris. At the same time, there are many complaints because almost all government money goes to a few large, often stagnating industries and because it is difficult to take advantage of the many types of subsidies that exist in France.

Things are changing, however. For example, a tax break has been introduced so that companies involved in research can deduct 25 percent of their increased research and development volume from their corporate taxes, not to exceed 3 million francs, however.

The government agency ANVAR (National Agency for the Implementation of Research) gives two types of support to existing companies. "Prime 1'Innovation" means a 25-percent contribution toward external assistance with patents, documentation, research, testing, etc., while "Aide a 1'Innovation" means loans of 50 percent toward the cost of preliminary studies. This money is to be paid back if the project is successful. The latter type of support, which is the more common of the two, was estimated at 820 million francs in 1983.

The National Agency for the Creation of Businesses assists new, technically oriented companies with their administrative problems.

Perhaps even more important, however, is the decision to give employees who want to start their own business a 2-year leave of absence from their regular job and to give new companies a 3-year total tax exemption.

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FRG DEBATES COMPETITIVENESS, EFFICACY OF DOMESTIC R & D

Bundestag Discussion

Duesseldorf VDI NACHRICHTEN in German 3 Feb 84 p 2

[Text] In the debate in the Bundestag on the interpellation by the CDU and FDP fractions to the Federal Government on the "new orientation of research and technology policy," it became clear in Bonn on 26 January that in the case of research objectives, the common interests between the government and the SPD opposition continue to predominate. On the other hand, the Greens are insisting that research policy must not be subordinated to the goal of ensuring the international competitiveness of the FRG, but that it must be oriented exclusively toward ecological necessities.

In the Bundestag debate on the interpellation by the CDU and FDP on the new orientation of research and technology policy in the FRG, Federal Research Minister Dr Heinz Riesenhuber emphasized that despite a stronger competition from Japan and increasingly also from the emerging countries, German businesses have retained first place in exports of industrial goods among the OECD countries (in front of the United States and Japan), with a share of about 18 percent. In his opinion, pessimistic critics of the productivity of German industry underestimate its outstanding technical achievements in such fields as plant construction, machine-building, and the automotive industry, as well as in chemistry.

Nevertheless, Minister Riesenhuber also cannot fail to notice certain alarm signals. In the case of some leading technologies, our industry is in danger of falling behind, he said. He reduced the results of the most recent investigations on this to the formula: "The situation is still good, but the dynamics show weaknesses." This is true, he said, especially in office automation, communications technology, metrology and automatic control engineering, aircraft and space vehicles, and electro-medicine. In the "high-technology areas," an analysis by the American Department of Commerce shows that between 1978 and 1981, world production of integrated circuits increased to $14 billion. The German share of this is small. Although according to the analyses at hand the FRG has retained its share of world trade in high-technology goods on the whole, the share held by Japan has doubled in the last decade. In this connection, Japan has even managed by now to export more high-technology goods to the United States than it imports from there.

From this the federal research minister draws the conclusion that the FRG must strive to avoid missing the bus in these important fields. He believes that the measures introduced by him in the last year and a half are suited to this purpose, such as the encouragement of self-initiative in all sectors, the reintroduction of special depreciations for research and development investments from 1984 on, the indirect-specific development program on manufacturing technology, the model experiment on founding technology-oriented businesses, as well as the improvement of technology transfer from research institutions.

The SPD opposition in the Bundestag interprets the current research-policy situation differently: "It pains me to see how the federal research minister is under the thumb of the federal economics minister," Dr Ulrich Steger, spokesman of the SPD Bundestag fraction for research and technology, exclaimed before the plenum. He said that the blame for the failure of an overall plan for information technology has lain with the dogmatic free-market objections of Count Lambsdorff, and that this is a tragedy for our country.

He said that the "comprehensive plan for promoting the development of microelectronics and information and communication technologies" announced in the government policy statement of 4 May 1983 for the end of November of last year is now apparently being downgraded to an innocuous "government report." Thus urgent decisions for the sake of promoting future technologies were not being made. Whereas even industry is demanding a far-sighted structural policy for future technologies, the coalition is becoming bogged down in abstract debates on principles of regulative policy.

In the opinion of Lothar Fischer, likewise a social-democratic Bundestag deputy, research policy shapes the future. Therefore governmental assistance to research and development is an important component of a policy which provides for the future. He is certain that research work on the conservation of resources and on the preservation of the natural environment will have a central importance in the future. In the research-policy debate, he called on the Federal Government to work out, in cooperation with the large research institutions (whose future development was likewise a subject of debate), a plan on the more long-range specific tasks of the separate large research institutions.

In this debate, the CDU Bundestag deputy Erich Maass called on the large research institutions to take advantage of the opportunities which have been given to them now from the improved basic research conditions, by showing more flexibility on their part. He suggested further that in the future the scientific workers in large research institutions should leave their ivory towers more often in order to work for a limited period of time in industry. He said that we must pass from a stage of coexistence between science and industry into a phase of cooperation. Therefore the priorities of the large research institutions must be reconciled better with the research and development needs of the economy.

His colleague in the fraction, Dr Josef Bugl, supported his view that an important task of government research and technology policy is to facilitate technology transfer. He said that experience has shown that the best transferring of research results and methods into practice takes place by way of those scientists who move from a research institution to an industrial enterprise. He too called on the large research institutions to avoid developing into "research fortresses."

The research plan of the Greens showed itself to be completely contrary to the views of the government and the SPD opposition. Dr Erika Hickel called on the government and the plenum to define completely new objectives for research policy. From the principle of the Greens on the desirability of achieving "a life at peace with nature," she deduced that government support of research must put an emphasis on the sector of regenerative energies. Also environmental research must be intensified, in order to allow life without "poisons in the daily routine." Moreover Mrs Hickel also insisted on more research to allow people to do work of their own choosing. Also the concept of leading technology must be completely redefined; it must be oriented towards ecological objectives and not toward "prescriptions from the United States," which are of questionable value for these objectives. All in all, a new orientation of research policy must result in a new understanding of nature, in view of the developing ecological catastrophe.

Economic Institute Releases Study

Duesseldorf VDI NACHRICHTEN in German 3 Feb 84 p 6

[Text] Both on the world market and domestically, German industry has lost considerably in importance as a supplier of technology-intensive goods. This is pointed out by four of the five economic institutes in their 1983 structural reports now being submitted. Only the German Institute for Economic Research (DIW), Berlin, recalls the favorable competitive position of the FRG in the 1970's, which it said can be attributed above all to specialization and to the quality of the products produced.

What is particularly astonishing is the unanimously negative assessment by four of the institutes as to the effect of governmental support of research. Only the DIW remarks that the expansion of the support for research and development is making a positive difference, "even if its significance is relatively slight." The Rhine-Westphalian Institute for Economic Research (RWI), Essen, does not see any increase in employment ensuing from intensive government support for research in the branches of aircraft and space vehicles, electrical engineering, and precision mechanics/optics. The HWWA [Hamburg World Economy Archives] Institute for Economic Research, Hamburg, writes that selective subsidies for highly technology-intensive projects in the aeronautics and space industry have often turned out to be a disappointment. Like the other institutes, The Institute for World Economy (IfW), Kiel, views the subsidy policy as being just as structure-conserving as ever. The Ifo Institute for Economic Research, Munich, acknowledges some success "at most from the heavy assistance given to aircraft and space-vehicle construction."

On the basis of patent investigations, the Ifo Institute comes to the conclusion that advanced research in Germany is falling behind internationally. Although research and development in the FRG have been "definitely oriented toward growing technology fields, nevertheless German research management apparently shies away from the risks which are present in dealing with completely new research subjects." Moreover in the case of research-intensive undertakings one obstacle to innovation is that often the suitable scientists are not found. Although the Ifo innovation and investment surveys have discovered a high proportion of innovative investments (almost half), it says that nevertheless this is qualified by the type of innovations and the extensive concentration on road-vehicle manufacturing. The IfW as well suggests this sort of wrong weighting of innovations: Little readiness to make structural changes, resistance to technical reforms, reticence in making capital expenditures, and governmental regimentation are delaying a broad application of modern technologies.

This is becoming noticeable also in exports. The HWWA stated that the typical profile of an industrial country is receding in the case of the FRG, and that with the exception of automobile manufacturing, in the large exporting branches (chemistry, electrical engineering, machine-building) above-average losses in market share can be noted. Ifo as well declares that German exports are concentrated in groups having a stagnant or declining share in world trade. Especially in machine-tool building, the "microelectronics gap" is making itself felt. Of those fields with a promising future, the FRG is above the average only in the field of electro-medicine. "In the markets for new technologies, frequently others are a nose ahead," declares the IfW. Japan above all, with its "high-technology offensive," is meant by this (Ifo), but also the United States. The FRG has become a net importer for leading-technology goods (HWWA). The greatest danger for the German economy lies in the increasing tendency to turn to defensive strategies (IfW); when a country turns a deaf ear to the challenges of structural change, it gambles away its future.

To be sure, among occupations which are strongly affected by technologies the RWI discovers a positive employment balance, in contrast to the "structure-dominant" activities with a negative balance. But Ifo calls attention to the fact that a million additional jobs requires an additional capital input of DM 160 to 220 million, but in the foreseeable future not enough businesses will turn up which will engage in capital expenditures on extensions to such a notable extent, because "the analyses on technological competitive positions give little hope that in the near future industry will have a range of goods on offer with more growth potential than hitherto."

Several institutes point to a positive aspect of the energy shortage: The high energy-price level is stimulating technological development, the use of energy is becoming more efficient (RWI), and energy-intensive industries in the FRG are definitely competitive (DIW). In contrast to the otherwise widespread lack of flexibility, such as in the labor market, there is considerable flexibility in the energy markets (IfW).

For all the institutes, the key to the future of German industry lies in technological development and innovation. But the readiness of businesses to make innovations and take risks leaves much to be desired.

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BRIEFS

FRG CENTER FOR 'INNOVATIVE COMPUTERS'--A "research center for innovative computer systems" has been established by the Association for Mathematics and Data Processing (GMD), with operation beginning on 1 November 1983 at the Technical University of Berlin. Through joint research and development programs, the GMD and the Technical University of Berlin intend to further research in the field of new computer systems. Prof Wolfgang K. Giloi of the computer science department at the Technical University was appointed to be head of the research center. [Text] [Stuttgart BILD DER WISSENSCHAFT in German Jan 84 p 31] 12114

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